TESTING OF UNDERGROUND PETROLEUM STORAGE TANK SYSTEMS

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Alberta MUST PROJECT
Management of Underground Storage Tanks

A Joint Project of the Departments of Environment and Labour

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1.0 INTRODUCTION

The old saying "out of sight, out of mind" applies perfectly to underground storage tank systems. However, Underground Storage Tank (U.S.T.) systems are an increasing environmental and public safety concern. Thousands of U.S.T.'s were installed across Alberta in the 1950's, 60's and 70's. Most of these were made of painted or unprotected steel, making them susceptible to corrosion. This corrosion may eventually penetrate the tank, causing a leak.

Periodic checks and maintenance of tank systems are essential to preventing and identifying leaks. Some examples of the preventative maintenance that can be done includes voltage checks on cathodic protection equipment, inspections of unions under the pump and periodic leak testing.

Leak testing enables the tank owner to determine if a system he owns can be considered "tight". If a system does not test "tight", the owner may assume that he has a leaking underground storage tank system. This is the most reliable way to determine if a system is leaking and is usually done to confirm a suspicion aroused by other indicators such as a continuously negative inventory balance or the presence of water in the tank.

Precision leak tests should be performed whenever a tank owner suspects a leak. Several things may indicate that a tank is leaking and these should be thoroughly investigated prior to testing a tank. Some indicators that the tank owner should look for include:

- Five consecutive days of losses in product inventory reconciliation;
- 18 days of losses in product inventory reconciliation during a single calendar month;
- Unexplainable appearance of water in the tank;
- Faulty or hesitating product flow (suction type pumping systems).
- Appearance of free product or vapors in nearby underground structures (such as basements, utility vaults, parkades, etc.) or seepages to the ground surface or a nearby water body.

By testing each tank system, the tank owner helps control liability at a site. Early detection of a leaking tank system allows the owner to take corrective actions before major environmental damage is done and/or public safety is at risk. In Alberta, an average underground storage tank site decommissioning and clean-up costs $40-$60,000.00 and may cost up to $1,000,000.00 where there is a major leak.

2.0 METHODS FOR TANK TESTING

2.1 Overview

There are three commonly used methods for testing the integrity of underground storage tank systems. These are pneumatic tests, liquid media (also known as hydrostatic or volumetric tests) and non-volumetric tests.

Pneumatic tests work on the principle of monitoring air pressure within the tank to detect a leak. Hydrostatic tests utilize precise measurements of liquid within the tank to determine system integrity. The accuracy of both methods can be detrimentally affected by temperature and pressure variations. Non-volumetric test methods rely on being able to monitor a tracer gas put in the tank or acoustic signals generated by depressurizing the tank.

Of these three methods, the hydrostatic test is most commonly used to test the "tightness" of existing tank systems. The test method has been in use since the 1960's and since that time many different tank testers have been developed using the hydrostatic principle. Various test methods along with their accuracy and reliability figures are shown in Table A.

2.2 Use of Pneumatic Leak Tests

Pneumatic leakage tests are used only when the tank system is new or has been safely purged of explosive vapours and only when the test is conducted in accordance with requirements of the Alberta Fire Code (AFC).

Because of its very limited accuracy, pneumatic leakage testing should not be used when the storage tank or associated piping is suspected of leaking. When an underground storage tank system is suspected of leaking, an approved hydrostatic or volumetric leakage test or other approved leakage test shall be done.

2.3 Liquid Medium Leakage Tests

Hydrostatic or volumetric leakage tests must be "precision" tests. To meet this criteria the testing system must have a detection limit of less than 0.38 L/hour with a probability of detection [P(D)] greater than or equal to 0.95 and a probability of false alarm [P(FA)] of less than or equal to 0.05.[1]

Liquid medium leak test methods which meet the above criteria are:

- Heath Petro Tite
- Horner Ezy-Chek II
- Leak Computer

See Table A (Tank Testing Methods Accuracy and Reliability).

Other methods may be added to this list provided they meet the accuracy and reliability objectives of 0.38 L/hour and .95/.05 P(D)/P(FA).

Non-precision test methods are not approved. The old "standpipe" type test, although hydrostatic, is not a precision method and is therefore not approved. Automatic tank gauging and inventory reconciliation records are not considered approved methods in any case.

2.4 Other Test Methods

Tests which do not utilize either pneumatic pressure or the hydrostatic principle are also available. These are often referred to as non-volumetric test methods. Non-volumetric test methods must meet the same criteria as liquid

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[1] Based on U.S. Environmental Protection Agency interim tank testing requirements. May be revised down to 0.19 L/hour in January 1991.

medium leakage tests (have a detection limit of less than 0.38 L/hour with a probability of detection greater than or equal to 0.95 and a probability of false alarm of less than or equal to 0.05.[2]

Presently the only test method which meets the above criteria is

- Vacutect (Tanknology Ltd.)

The Fire Commissioner may approve other methods provided they meet the accuracy and reliability objectives of 0.38 L/hour and .95/.05 P(D)/P(FA).

3.0 REQUIREMENTS UNDER THE ALBERTA FIRE CODE

The AFC requires that every storage tank and its associated piping be tested for leakage by an approved[3] test method

(a) at the time of installation;

(b) before being put into service or;

(c) whenever a leak is suspected (AFC, s.215(1) & s.230(1)).

Presently, testing of the tank system may be done by either an air medium or inert gas (pneumatic) leakage test or by a liquid medium (hydrostatic) leakage test . In both cases, records of the test must be retained for at least two years and must be produced for examination upon the request of the local assistant or fire inspector.

3.1 Pneumatic Leakage Tests

The use of pneumatic leakage tests are not allowed where the storage tanks contain flammable or combustible liquid (AFC, s.217(2)). This stipulation largely limits the use of pneumatic leakage tests to new tank installations

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[2] Based on U.S. Environmental Protection Agency interim tank testing requirements. May be revised down to 0.19 L/hour in January 1991.

[3] Approved is defined in the Alberta Fire Code as being acceptable to the Fire Commissioner.

only.

When a pneumatic leak test is performed, the tank shall be considered to be leaking when any pressure drop is detected within a two hour period after steady temperature conditions have been established and the source of pressure has been removed (AFC, s.217(3)). Should a leak be detected, the tank shall be replaced. (AFC, s.216).

To detect a leak, test pressures shall be measured by an instrument calibrated in increments not greater than 1 kPa (AFC, s.217(4)). Test pressures must be at least 30 kPa but not exceed 35 kPa (for safety reasons) in the case of uncovered tanks and must be at least 35 kPa but not exceed 70 kPa (for safety reasons) in the case of completely buried tanks (AFC, s.217(5),217(6)).

Because pneumatic testing of storage vessels can be dangerous, measures shall be taken to guard against the hazards associated with pneumatic leakage testing where explosive mixtures of vapours from flammable or combustible liquids and air may be present in the area of a tank that has been in use (AFC, s.217(7)).

These measures may include using a combustible vapours detector to identify hazardous situations, roping off area to public, ensuring fire and first aid equipment is on-site, removal of spark producing devices and open flames, etc.

3.2 Hydrostatic or Volumetric Leakage Tests

Hydrostatic or volumetric leakage tests may be used on either new or existing underground storage tank systems. Use of either water or combustible/flammable liquids for which the tank is intended are acceptable.

Where a hydrostatic or volumetric leakage test is employed, the tank shall be considered to be leaking when, with compensation for volume differentials caused by the effects of temperature and tank shell distortion, the test indicates a liquid loss. (AFC, s.218(1)). Should a leak be detected, the tank shall be replaced and the escaped liquid removed (AFC, s.139 & s.216) section 139 (AFC, s.216).

During a hydrostatic or volumetric leakage test the pressure at the bottom of the tank shall not exceed 70 kPa (AFC, s.218(2)).

3.3 Approved Test Methods

Tank test methods, their approved usage and criteria for approval are summarized in Table B. This table shows approved methods only. For further information on approval of test methods contact the Fire Prevention Branch of Alberta Labour.

4.0 RECOMMENDED PRACTICES FOR TESTING OF UNDERGROUND STORAGE TANK SYSTEMS

Tank owners and operators need to be aware of what is required when they have a tank tested. This section outlines some practices that should be followed by the tank owner and by the tank tester when testing an underground storage tank.

4.1 Use of Certified Testing Agents

The majority of precision leak testing equipment is sold under license by the manufacturer to testing agents. These agents may or may not be certified by the manufacturer as a person who is qualified to operate the tank tester equipment. Because of the complex nature of testing tanks and specific knowledge required to successfully test a tank, it is strongly recommended that tank owners specify testing agents that have attended a testing course and who are certified by the manufacturer.

4.2 Documentation of Test Results

Any leakage tests done on an underground storage tank must be documented. The documentation should include a copy of the actual test results and a summary report. A recommended format for the summary report is attached. This documentation must be retained for a minimum of two years (AFC, s.215(4)) but ideally should be kept for the life of the tank or until it is retested.

4.3 Ratification of Test Results

Tank owners should have the tank tester verify the results of the tank test with a signature. This ratification will help ensure that the test is conducted as conscientiously as possible.

4.4 Tank Size Limitations

Tank size may become a limitation in accurately assessing the integrity of large underground storage tank systems using the liquid medium test methods described in Section 2.3. Loss detection becomes increasingly difficult as tank size increases.

In order to conduct meaningful tests on tanks or manifolded systems with combined capacity greater than 45,000 L, special adaptors or test procedures may be required.

TABLE A. TANK TESTING METHODS ACCURACY AND RELIABILITY

METHOD	ACCURACY	RELIABILITY
Vacutect (by Tanknology)	0.38 L/hr.[1] 0.08 Imp. gal/hr.	P(D) = 95%[1] P(FA) = 5%
Heath Petro Tite	0.30 L/hr.[2] 0.07 Imp. gal/hr.	P(D) = 95%[2] P(FA) = 5%
Horner Ezy-Chek I	0.62 L/hr.[3] 0.14 Imp. gal/hr.	P(D) = 95%[3] P(FA) = 5%
Horner Ezy-Chek II	0.288 L/hr.[4] 0.06 Imp. gal/hr.	P(D) = 95%[4] P(FA) = 5%
Leak Computer (by Hasstech)	0.30 L/hr.[3] 0.07 Imp. gal/hr.	P(D) = 95%[3] P(FA) = 5%
Pneumatic	Unknown	Unknown
Hydrostatic	Unknown	Unknown

[1] From Midwest Research Institute
[2] From Midwest Research Institute (for tanks to 38,000 L)
[3] From EPA test data
[4] From third party evaluation (Fairbanks Scales)

TABLE B. TANK TEST METHODS, APPROVED USAGE AND CRITERIA FOR APPROVAL

TANK TEST METHOD		APPROVED USAGE	CRITERIA FOR APPROVAL
PNEUMATIC (AIR PRESSURE)		- NEW OR HC* VAPOUR PURGED ONLY	- MUST MEET A.F.C. s.215, 217, 233
HYDROSTATIC	HEATH PETRO-TITE HORNER EZY-CHEK II	- NEW AND EXISTING TANKS	- MUST MEET A.F.C. s.215, 218
HYDROSTATIC	LEAK COMPUTER	- AS "PRECISION" TEST FOR SUSPECTED LEAKERS	- MUST MEET E.P.A. ACCURACY/ RELIABILITY OBJECTIVES
OTHER	VACUTECT	- NEW AND EXISTING TANKS - AS "PRECISION" TEST FOR SUSPECTED LEAKERS	- MUST MEET A.F.C. s.215, 218 - MUST MEET E.P.A. ACCURACY/RELIABILITY OBJECTIVES

* Hydrocarbon

UNDERGROUND STORAGE TANK SYSTEM TEST REPORT

Provincial Government Facility ID #_____

PLEASE PRINT

1. OWNER Property
   1) _____
   Name | Address | Representative | Phone

   Tanks
   2) _____
   Name | Address | Representative | Phone

2. OPERATOR
   _____
   Name | Address | Representative | Phone

3. REASON FOR TEST
   (Explain fully)

4. WHO REQUESTED TEST AND WHEN
   _____
   Name | Title | Company or Affiliation | Date

   _____
   Address | Phone

5. TANK INVOLVED

   Use additional lines lines for manifolded tanks.

	Identify by Direction	Capacity	Brand/ Supplier	Grade	Approx. Age	Steel/ Fiberglass
1)						
2)						
3)						
4)						

6. TESTING FIRM
   _____
   Name | Address | Representative | Phone

7. TEST METHOD

8. OTHER INFORMATION
   Additional info. on any items above, officials others to be advised when testing is in progress or completed. Visitors/ observers present during test etc.

9. TEST RESULTS

   Tests were made on the above tank systems in accordance with test procedures prescribed for as detailed on attached test charts with results as follows:

	Tank ID	Tight	Leakage Indicated	Date Tested
1)				
2)				
3)				
4)				

10. TANK TESTER CERTIFICATION

This is to certify that these tank systems were tested on the date(s) shown. Those indicated as "Tight" meet the criteria established by the Alberta Fire Prevention Branch.

Technicians

1) _____ _____
Testing Contractor or Company by Signature

Certification #_____ _____
Address

2) _____ _____
Testing Contractor or Company by Signature

Certification #_____ _____
Address

UNDERGROUND STORAGE TANK SYSTEM TEST REPORT

Provincial Government Facility ID #_____

PLEASE PRINT

1. OWNER Property
   1) _____
   Name | Address | Representative | Phone

   Tanks
   2) _____
   Name | Address | Representative | Phone

2. OPERATOR
   _____
   Name | Address | Representative | Phone

3. REASON FOR TEST
   (Explain fully)

4. WHO REQUESTED TEST AND WHEN
   _____
   Name | Title | Company or Affiliation | Date

   _____
   Address | Phone

5. TANK INVOLVED

	Identify by Direction	Capacity	Brand/ Supplier	Grade	Approx. Age	Steel/ Fiberglass
1)						
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Certification #_____ _____
Address

2) _____ _____
Testing Contractor or Company by Signature

Certification #_____ _____
Address